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ing numbers represent one of several measurements which I made on wire of the same diameter: —

Wire 100 cm. in length	. . . . .	2 waves	to 5 mm.
" 50 cm. "	. . . . .	4 "	"

Thus the wave lengths were found to be proportional to the lengths of the wire. The interference of waves in an elliptical vessel, caused by producing the vibrations at the two foci, and described by the brothers Weber in their *Wellenlehre*, can be beautifully shown by this method.

No. XVII. — VIBRATIONS OF CIRCULAR AND ELLIPTICAL PLATES.

By Francis E. Cabot.

Presented May 14, 1879.

The experiments from which the results given in the following paper were obtained were made with the idea of finding out whether a change in the ellipticity of a plate would have any effect on the nodal lines of such a plate.

I had seven plates of the same material, of equal thickness: one was a circle with a diameter of eight inches, and the others were ellipses, all having their major axes eight inches in length, and their minor axes decreasing, each by an inch, from seven to two inches in length. The ellipses I clamped close to the edge at both extremities of the minor axis. They were bowed at one extremity of the major axis. The circle was clamped close to the edge, at both extremities of a diameter, and bowed at 90° from the clamp.

Under these conditions, the nodal lines gave a series of similarly situated curves, which changed their curvature and position correspondingly to the change in the ellipticity of the plates. The circle gave a star-shaped figure with six points connected by curves of nearly equal curvature (Fig. 1). The ellipse whose minor axis was seven inches in length gave a line nearly an inch in breadth from the clamp to the point of clamping with two whose ends were equally distant from the major axis at the edge of the plate (Fig. 2). The curves, as we see by the figures, are of nearly the same curvature as the curves connecting the points of the star given by the circle. But in the next plate (Fig. 3), whose minor axis is six inches in length, the curves, though situated similarly to those in the last figure, are of a much smaller curvature. This decrease continues as the minor axis decreases, until, as we see in Fig. 5, the lines have become nearly, if not quite, straight.

Another point to be noticed is that in Fig. 4 we begin to see that the extremities of the curves are nearer together on the side where the clamp is than on the side damped by the finger, and this fact becomes very noticeable in Fig. 5.

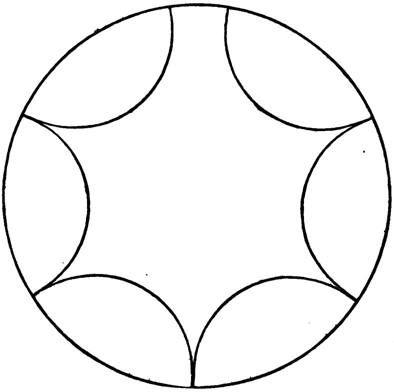

Fig. 1.

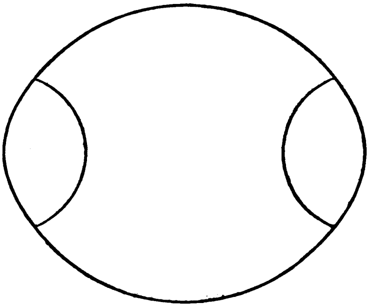

Fig. 2.

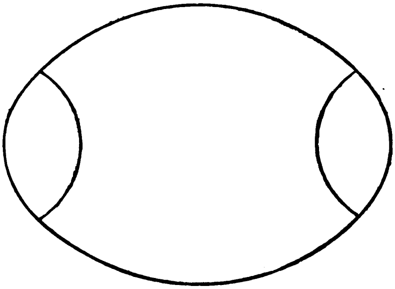

Fig. 3.

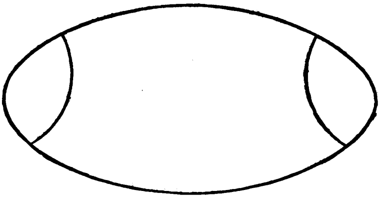

Fig. 4.

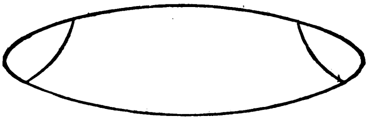

Fig. 5.

I also made a series of experiments with the same plates, clamped at one edge, damped in the centre, and bowed at a point about 70° from that extremity of the minor axis which was not clamped. Here, too, I obtained a series of curves similar to each other (Figs. 6 to 9), but differing largely from the last series, though we may notice that Fig. 9 resembles Fig. 5.

These two series of curves show conclusively that the arrangement of the curves is not materially altered by a change in the ellipticity when the plate is bowed at the edge, but that the curvature of the curves does correspond very closely to the change in the ellipticity of the plate. Furthermore, that the nearer the plate comes to a straight bar, the more the figures in the two series resemble each other; showing that the nearer the plate is to a circle, the more various are the figures obtained by damping and bowing in different places.

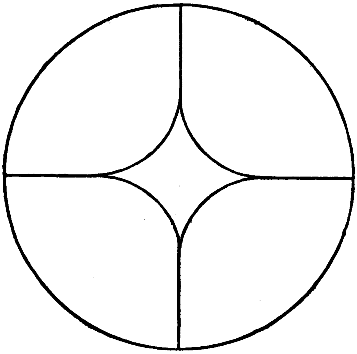
Fig. 6.

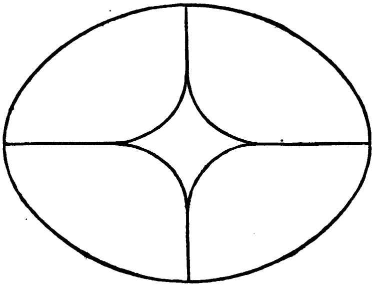
Fig. 7.

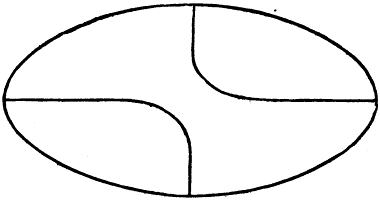
Fig. 8.

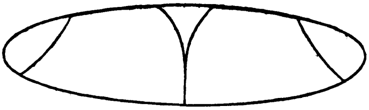
Fig. 9.

I also tried to obtain a series of similar curves by exciting the vibrations through a hole bored in the centre of the plate. But in this I failed; I could get a set of curves for two or three consecutive plates, but not throughout the whole set of plates. One fact which was particularly noticeable in connection with this set of experiments was, that five or six sets of curves resulted from bowing the same plate in apparently exactly the same way, although the plate gave a different note for each set of curves.

The results of these experiments can be summed up as follows: —

1. Certain fundamental vibrations of elliptical plates are not changed by wide variations in the ellipticity of the plates.
2. The vibrations of elliptical plates are less varied than those of circular plates. A small amount of ellipticity results in a quick and marked limitation in the variety of the vibrations of the plate.
3. It is to be conjectured, therefore, that an animal, whose ear is provided with an elliptical-shaped membrane, if such an animal exists, has less perfect powers of hearing than one provided with a circular membrane, as far as the variety of vibration of the membranes are considered.

No. XVIII. — PERFORATED VIBRATING DISCS.

By Francis E. Cabot.

Presented Dec. 10, 1879.

Since the membrane of the human ear is often perforated in auricular surgery without the destruction of the sense of hearing, at the suggestion of Professor Trowbridge I tried the effect of the removal of a large portion of the vibrating disc of a telephone. Three discs were made of ordinary tin-type plate; one with a hole in the centre half an inch in diameter; one with four holes, each half an inch in diameter, with their centres on two lines at right angles, crossing in the centre of the plate, and half-way from the centre to the edge of the disc; the third with four holes four fifths of an inch in diameter, and placed similarly to those last mentioned. Substituting these discs for the discs ordinarily used in a Bell telephone, I found that messages could be sent and received, but in a somewhat imperfect manner. On covering the holes with paper, I found that I could use either of the last two plates, in either the sending or receiving telephone, or in both, with nearly, if not quite, as good results as with the unperforated discs commonly used.

The disc with the hole in the centre did not give good results, as was to be expected, since the iron was taken away just in front of the magnet; but the others worked very well indeed. I also found that a disc of mica of the same size as the usual plate, with a piece of the